

## Claims

What is claimed is:

1. A steel guitar signal processing and control system comprising:
  - 2 a plurality of strings;
  - 4 a plurality of vibration-sensing transducers, wherein each vibration-sensing transducer of said plurality of vibration sensing transducers is coupled with an associated string of said plurality of strings, wherein each vibration-sensing transducer of said plurality of vibration-sensing transducers generates a distinct electrical transducer signal responsive to vibrations of said associated string;
  - 8 a plurality string signal processors, wherein each signal processor of said plurality of string signal processors is adapted to receive said electrical transducer signal generated by an associated vibration-sensing transducer of said plurality of vibration-sensing transducers, wherein each of said plurality of string signal processors shift the pitch of said electrical transducer signal according to a variable degree of pitch shift to generate an associated plurality of processed electrical signals, wherein at least one string processor control signal is used to vary a degree said pitch shift;
  - 16 a controllable mixer for mixing electrical transducer signals generated by said plurality of vibration-sensing transducers and said plurality of processed electrical signals generated by said plurality of signal processors to generate at least one outgoing audio signal, wherein a mixer control signal is used to control said mixing;
  - 20 a plurality of physical controllers generating an associated plurality of physical controller signals in response to user operation; and
  - 22 a control processor for generating said at least one string processor control signal and/or said mixer control signal according to a control signal algorithm responsive to one of said plurality of physical controller signals generated by said plurality of physical controllers.
  - 24
2. The system according to claim 1, wherein at least one of said plurality of physical controllers comprises a foot pedal.

3. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises a knee lever.

4. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises a wrist-operated controller.

5. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises an original position and a range of activated positions,  
wherein said at least one of said plurality of physical controllers remains at an activated  
4 position from said range of activated positions until a user repositions said at least one of  
said plurality of physical controllers to said original position.

6. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises an original position and a range of activated positions,  
wherein said at least one of said plurality of physical controllers automatically returns to  
4 said original position after being placed in an activated position.

7. The system according to claim 1, said system further comprising:  
2 a sliding steel bar having at least one of said plurality of physical controllers  
located on said sliding steel bar.

8. The system according to claim 7, wherein said at least one of said plurality  
2 of physical controllers located on said sliding steel bar is coupled to said control  
processor using a wireless link.

9. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises a pressure sensor, said system further comprising:  
a sliding steel bar having said pressure sensor located on said sliding steel bar.

10. The system according to claim 9, wherein said pressure sensor located on  
2 said sliding steel bar is coupled to said control processor using a wireless link.

11. The system according to claim 1, wherein at least one of said plurality of  
2 physical controllers comprises a position sensor, said system further comprising:  
a sliding steel bar having said position sensor located on said sliding steel bar, and  
4 wherein said position sensor provides the position of said sliding steel bar relative to said  
plurality of strings.

12. The system according to claim 11, wherein said control processor  
2 generates at least one outgoing bar position control signal responsive to said position of  
said sliding steel bar relative to said plurality of strings, said position indicated by said  
4 position sensor.

13. The system according to claim 12, wherein said at least one outgoing bar  
2 position control signal is a signal of MIDI format.

14. The system according to claim 1, said system further comprising:  
2 a mechanical tuning changer controlled by at least one mechanical actuator, said  
mechanical tuning changer responsively changing the tension of at least one string of said  
4 plurality of strings.

15. The system according to claim 14, wherein said at least one mechanical  
2 actuator further operates at least one of said plurality of physical controllers.

16. The system according to claim 14, wherein said at least one mechanical  
2 actuator comprises a foot pedal.

17. The system according to claim 14, wherein said at least one mechanical  
2 actuator comprises a knee lever.

18. The system according to claim 1, wherein at least one of said plurality of  
2 electrical transducer signals is provided to an audio-to-control signal extraction system,  
said audio-to-control signal extraction system responsively producing an outgoing  
4 extracted control signal.

19. The system according to claim 18, wherein said outgoing extracted control  
2 signal is a signal of MIDI format.

20. The system according to claim 1, wherein at least one string signal  
2 processor of said plurality of signal processors is further configured to change the timbre  
of said electrical transducer signal in response to said at least one string signal processor  
4 control signal.

21. The system according to claim 20, wherein at least one degree of pitch  
2 shift and at least one change in timbre made by said plurality of string signal processors  
are controlled simultaneously in response to the operation of one of said at least one  
4 operable controllers.

22. The system according to claim 1, wherein said controllable mixer is  
2 further configured to generate at least one submix signal independent of said mixing,  
wherein said at least one submix signal is provided to at least one timbre signal processor  
4 modifying the timbre of said at least one submix signal to generate a timbre-modified  
output signal, said timbre-modified output signal is provided to said controllable mixer  
6 for use in said mixing and said generation of said at least one outgoing audio signal.

23. The system according to claim 22, wherein at least one degree of pitch  
2 shift made by at least one of said plurality of string signal processors and a change in  
timbre made by said additional timbre signal processor are controlled simultaneously in  
4 response to the operation of one of said at least one operable controllers.

24. The system according to claim 1, wherein said control processor is further  
2 configured to generate an outgoing physical controller signal for one or more of said  
plurality of physical controller signals generated by said plurality of physical controllers.

25. The system according to claim 1, wherein said outgoing physical  
2 controller signal is a signal of MIDI format.

26. The system according to claim 1, wherein said control signal algorithm is  
2 selected from a plurality of pre-programmed control signal algorithms.

27. The system according to claim 26, wherein an incoming algorithm control  
2 signal of MIDI format is used to select a particular control signal algorithm from said  
plurality of pre-programmed control signal algorithms.

28. The system according to claim 1, wherein an incoming control signal of  
2 MIDI format is used by said control signal algorithm to generate said at least one string  
processor control signal and said mixer control signal.

29. The system according to claim 1, said system further comprising:  
2 at least one switch generating an associated at least one outgoing signal of MIDI  
format in response to user operation of said at least one switch.

30. The system according to claim 1, said system further comprising:  
2 at least one potentiometer generating an associated at least one outgoing signal of  
MIDI format in response to user operation of said at least one potentiometer.

31. The system according to claim 1, said system further comprising:  
2 at least one pushbutton generating an associated at least one outgoing signal of  
MIDI format in response to user operation of said at least one pushbutton.

32. The system according to claim 1, said system further comprising:  
2 a miniature keyboard comprising a plurality of keys, wherein each key of said  
plurality of keys generates an outgoing signal of MIDI format in response to user  
4 operation.

33. The system according to claim 1, said system further comprising:  
2 a strumpad comprising a plurality of touch switches, wherein each touch switch of  
said plurality of touch switches generates a touch switch signal in response to user  
4 contact, wherein a generated touch switch signal causes the generation of an outgoing  
signal of MIDI format, wherein said generation is performed according to an active  
6 mapping of possible touch switch signals to particular outgoing signals of MIDI format.

34. The system according to claim 33, said system further comprising:  
2 at least one processor for controlling said active mapping according to at least one  
processor control signal.

35. The system according to claim 33, wherein said active mapping is one  
2 mapping of a plurality of different mappings, wherein each mapping of said plurality of  
different mappings associate touch switch signals to particular outgoing signals of MIDI  
4 format.

36. The system according to claim 35, said system further comprising:  
2 a plurality of chord buttons, wherein each button of said plurality of chord buttons  
comprises a user selectable position that identifies said active mapping from said plurality  
4 of different mappings.

37. The system according to claim 36, wherein user operation of each button  
2 of said plurality of chord buttons generates at least one chord control signal.

2 38. The system according to claim 37, wherein said at least one chord control  
signal comprises an outgoing signal of MIDI format.

2 39. The system according to claim 35, said system further comprising:  
a plurality of foot switches, wherein each foot switch of said plurality of foot  
switches comprises user selectable positions collectively configured to select said active  
4 mapping from said plurality of different mappings.

2 40. The system according to claim 39, wherein user operation of each foot  
switches of said plurality of foot switches generates at least one chord control signal.

2 41. The system according to claim 40, wherein said at least one chord control  
signal comprises an outgoing signal of MIDI format.

2 42. The system according to claim 1, said system further comprising:  
a wrist controller adapted to control the volume of said at least one outgoing audio  
signal.

2 43. The system according to claim 1, said system further comprising:  
a multi-parameter foot pedal comprising at least two physical controllers of said  
plurality of physical controllers.

44. A method for signal processing and generating control signals for a steel  
2 guitar, said method comprising:  
coupling a separate vibration-sensing transducer with an associated string of a  
4 plurality of strings, wherein each vibration-sensing transducer of said plurality of  
vibration-sensing transducers generates a distinct electrical transducer signal responsive  
6 to vibrations of said associated string;  
generating a plurality of processed electrical signals using an associated plurality  
8 string signal processors, wherein each signal processor of said plurality of string signal  
processors is adapted to receive said electrical transducer signal generated by an  
10 associated vibration-sensing transducer of said plurality of vibration-sensing transducers,  
wherein each of said plurality of string signal processors shift the pitch of said electrical  
12 transducer signal according to a variable degree of pitch shift to generate said plurality of  
processed electrical signals, wherein at least one string processor control signal is used to  
14 vary a degree said pitch shift;  
using a controllable mixer for mixing electrical transducer signals generated by  
16 said plurality of vibration-sensing transducers and said plurality of processed electrical  
signals generated by said plurality of signal processors to generate at least one outgoing  
18 audio signal, wherein a mixer control signal is used to control said mixing;  
generating a plurality of physical controller signals in response to user operation  
20 using an associated plurality of physical controllers; and  
generating said at least one string processor control signal and/or said mixer  
22 control signal using a control processor, wherein said generating is performed according  
to a control signal algorithm responsive to one of said plurality of physical controller  
24 signals generated by said plurality of physical controllers.

45. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises a foot pedal.

46. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises a knee lever.

47. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises a wrist-operated controller.

48. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises an original position and a range of activated positions,  
wherein said at least one of said plurality of physical controllers remains at an activated  
4 position from said range of activated positions until a user repositions said at least one of  
said plurality of physical controllers to said original position.

49. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises an original position and a range of activated positions,  
wherein said at least one of said plurality of physical controllers automatically returns to  
4 said original position after being placed in an activated position.

50. The method according to claim 44, wherein a sliding steel bar having at  
2 least one of said plurality of physical controllers is located on said sliding steel bar.

51. The method according to claim 50, wherein said at least one of said  
2 plurality of physical controllers located on said sliding steel bar is coupled to said control  
processor using a wireless link.

52. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises a pressure sensor, and wherein a sliding steel bar having  
said pressure sensor is located on said sliding steel bar.

53. The method according to claim 52, wherein said pressure sensor is located  
2 on said sliding steel bar and coupled to said control processor using a wireless link.

54. The method according to claim 44, wherein at least one of said plurality of  
2 physical controllers comprises a position sensor, wherein a sliding steel bar having said  
position sensor is located on said sliding steel bar, and wherein said position sensor  
4 provides the position of said sliding steel bar relative to said plurality of strings.

55. The method according to claim 54, wherein said control processor  
2 generates at least one outgoing bar position control signal responsive to said position of  
said sliding steel bar relative to said plurality of strings, said position indicated by said  
4 position sensor.

56. The method according to claim 55, wherein said at least one outgoing bar  
2 position control signal is a signal of MIDI format.

57. The method according to claim 44, wherein a mechanical tuning changer  
2 is coupled to at least one string of said plurality of strings, wherein said mechanical  
tuning changer is controlled by at least one mechanical actuator, said mechanical tuning  
4 changer responsively changing the tension of at least one string of said plurality of  
strings.

58. The method according to claim 57, wherein said at least one mechanical  
2 actuator further operates at least one of said plurality of physical controllers.

59. The method according to claim 57, wherein said at least one mechanical  
2 actuator comprises a foot pedal.

60. The method according to claim 57, wherein said at least one mechanical  
2 actuator comprises a knee lever.

61. The method according to claim 44, wherein at least one of said plurality of  
2 electrical transducer signals is provided to an audio-to-control signal extraction system,  
said audio-to-control signal extraction system responsively producing an outgoing  
4 extracted control signal.

62. The method according to claim 61, wherein said outgoing extracted  
2 control signal is a signal of MIDI format.

63. The method according to claim 44, wherein at least one string signal  
2 processor of said plurality of signal processors is further configured to change the timbre  
of said electrical transducer signal in response to said at least one string signal processor  
4 control signal.

64. The method according to claim 63, wherein at least one degree of pitch  
2 shift and at least one change in timbre made by said plurality of string signal processors  
are controlled simultaneously in response to the operation of one of said at least one  
4 operable controllers.

65. The method according to claim 44, wherein said controllable mixer is  
2 further configured to generate at least one submix signal independent of said mixing,  
wherein said at least one submix signal is provided to at least one timbre signal processor  
4 modifying the timbre of said at least one submix signal to generate a timbre-modified  
output signal, said timbre-modified output signal is provided to said controllable mixer  
6 for use in said mixing and said generation of said at least one outgoing audio signal.

66. The method according to claim 65, wherein at least one degree of pitch  
2 shift made by at least one of said plurality of string signal processors and a change in  
timbre made by said additional timbre signal processor are controlled simultaneously in  
4 response to the operation of one of said at least one operable controllers.

67. The method according to claim 44, wherein said control processor is  
2 further configured to generate an outgoing physical controller signal for one or more of  
said plurality of physical controller signals generated by said plurality of physical  
4 controllers.

68. The method according to claim 44, wherein said outgoing physical  
2 controller signal is a signal of MIDI format.

69. The method according to claim 44, wherein said control signal algorithm  
2 is selected from a plurality of pre-programmed control signal algorithms.

70. The method according to claim 69, wherein an incoming algorithm control  
2 signal of MIDI format is used to select a particular control signal algorithm from said  
plurality of pre-programmed control signal algorithms.

71. The method according to claim 44, wherein an incoming control signal of  
2 MIDI format is used by said control signal algorithm to generate said at least one string  
processor control signal and said mixer control signal.

72. The method according to claim 44, wherein at least one switch is used to  
2 generate an associated at least one outgoing signal of MIDI format in response to user  
operation of said at least one switch.

73. The method according to claim 44, wherein at least one potentiometer is  
2 used to generate an associated at least one outgoing signal of MIDI format in response to  
user operation of said at least one potentiometer.

74. The method according to claim 44, wherein at least one pushbutton is used  
2 to generate an associated at least one outgoing signal of MIDI format in response to user  
operation of said at least one pushbutton.

2       75.     The method according to claim 44, wherein at least one miniature  
keyboard comprising a plurality of keys is used to generate an outgoing signal of MIDI  
format in response to user operation of each key of said plurality of keys.

2       76.     The method according to claim 44, wherein a strumpad is coupled to said  
steel guitar, said strumpad comprising a plurality of touch switches, wherein each touch  
switch of said plurality of touch switches generates a touch switch signal in response to  
4     user contact, wherein a generated touch switch signal causes the generation of an  
outgoing signal of MIDI format, wherein said generation is performed according to an  
6     active mapping of possible touch switch signals to particular outgoing signals of MIDI  
format.

2       77.     The method according to claim 76, wherein at least one processor is used  
for controlling said active mapping according to at least one processor control signal.

2       78.     The method according to claim 76, wherein said active mapping is one  
mapping of a plurality of different mappings, wherein each mapping of said plurality of  
different mappings associate touch switch signals to particular outgoing signals of MIDI  
4     format.

2       79.     The method according to claim 78, wherein a plurality of chord buttons  
are coupled to said steel guitar, wherein each button of said plurality of chord buttons  
comprises a user selectable position that identifies said active mapping from said plurality  
4     of different mappings.

2       80.     The method according to claim 79, wherein user operation of each button  
of said plurality of chord buttons generates at least one chord control signal.

2       81.     The method according to claim 80, wherein said at least one chord control  
signal comprises an outgoing signal of MIDI format.

82. The method according to claim 78, wherein a plurality of foot switches are  
2 coupled to said steel guitar, wherein each foot switch of said plurality of foot switches  
comprises user selectable positions collectively configured to select said active mapping  
4 from said plurality of different mappings.

83. The method according to claim 82, wherein user operation of each foot  
2 switches of said plurality of foot switches generates at least one chord control signal.

84. The method according to claim 83, wherein said at least one chord control  
2 signal comprises an outgoing signal of MIDI format.

85. The method according to claim 44, wherein a wrist controller is coupled to  
2 said steel guitar, said wrist controller adapted to control the volume of said at least one  
outgoing audio signal.

86. The method according to claim 44, wherein a multi-parameter foot pedal  
2 is coupled to said steel guitar, said multi-parameter foot pedal comprising at least two  
physical controllers of said plurality of physical controllers.

87. The system according to claim 34, wherein said control processor  
2 comprises said at least one processor.

88. The method according to claim 77, wherein said control processor  
2 comprises said at least one processor.